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VINTAGE SOUND ITEMS

THE HORN SPEAKER

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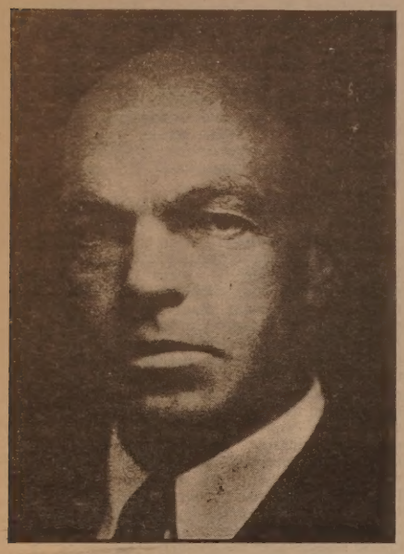


Major Edwin H. Armstrong

FREQUENCY MODULATION AND ITS FUTURE USES

MARCH, 1942

MAJOR EDWIN H. ARMSTRONG

Prof. of Electrical Engineering, Columbia University

ONCE in a while an invention is made that overcomes so many of the problems with which an industry has been contending that its methods are quickly recognized as the right ones to follow by those who understand its technical phases. Sometimes the new invention fits nicely into the established financial structure of an industry; sometimes it does not. In the one case, the inventor is met with open arms; in the other, he probably is assured that he really has a very fine invention and that if the art were starting out afresh no doubt it would be adopted, but to replace the existing plant—even though obviously it is now obsolete—would be too staggering a thing to be considered.

History teaches that the best method inevitably forces its way into use and ultimately becomes standard. Sixty years ago the electric light and power industry started off on the wrong road in its method of distribution. It undertook to distribute electric power, using the best; in fact, it used the only practical method at the time, namely, the low-voltage direct current system. Some years later the soundness of this procedure was challenged by the high-voltage alternating current system which, surmounting all obstacles placed in its path, went forward against powerful opposition and eventually superseded the direct current system in over 90 per cent of its applications. Looking back, one can see the absolute inevitableness of this result, yet the literature during the time of transition reflects a period of most violent controversy.

A large part of the radio industry, particularly the broadcasting division, is now facing a similar transition period, for a new principle has been discovered which furnishes a solution to the problem of "static." This term includes all those disturbances which have their origin in natural causes, such as lightning storms, and all those man-made noises which have their origin in the various kinds of electrical machinery found in towns and cities, such as electric razors, refrigerators, oil-furnace motors, elevators, etc. This new principle makes use of a process known as *"frequency modulation,"* although much more than a method of modulation is involved.

SOLVES MANY PROBLEMS

The new method solves not only the noise problem but many others which are inherent in the existing system. Due to a number of reasons, present-day broadcasting can transmit and reproduce only a part of the musical range; that is, instead of transmitting the range of 30 to 15,000 cycles which is required for natural reproduction, the range of 30 to 5,000 cycles is about the limit in present practice. In addition, this restricted part of the range which is actually utilized is reproduced none too faithfully by the existing system, on account of various distortions which occur in different parts of the transmitting and receiving equipment. Because of these limitations a radio "sounds like a radio." The new method is capable of transmitting the full frequency range (30 to 15,000 cycles), with a minimum of distortion and with practically the full dynamic range (i.e., maintenance of the proper relative amplitudes of the loudest and softest notes) that is required, so that it is possible to obtain a naturalness of reproduction never before achieved; in short, a reproduction which does not sound "like a radio."

The solution of these problems alone would warrant the application of the new technical methods, even though nothing more was accomplished than the paralleling of the existing service by the new system and the gradual transfer of the listening audiences per se from the old to the new type of broadcasting. But there is another contribution which this system can make that has very great social and political significance.

For years there has been a shortage of "wave lengths" or channel space, and the attempt to allocate equitably the inadequate facilities available has been the bane of the existence of those charged with this duty. With present methods, no permanent solution is possible; in fact, the interference situation has become worse in recent years due to increases in the number of stations operating in the United States and to the construction and operation at high power of numerous stations located beyond our southern borders.

The new system offers a solution not only to the national and international interference problem, but to the problem of giving every community one or more channels on the air so that stations particularly adapted to local needs can be set up and operated without interference. This result has come about because the system operates most effectively on wave lengths hitherto not put to use and because it has a curious immunity to interference from other frequency modulation stations, even though they may be on the same wave length channel. It becomes possible, therefore, to place stations much closer together geographically, and consequently to permit the use over and over again of the same channel within the confines of the United States. So effectively can this be done that the number of available channels may easily exceed the demand, with the factor which determines whether or not a community may have a local service resting solely upon the community's ability to support it. This alone would insure the adoption of the new system.

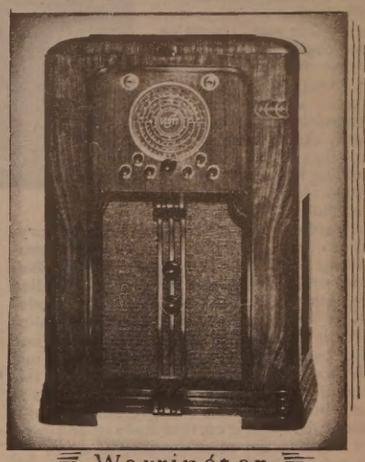
TRANSMITTING THE SPOKEN WORD

It is beyond the scope of this article to describe the technical processes by which these results are accomplished. They were originally described in a paper presented before the Institute of Radio Engineers in November of 1935, and to date no question has arisen as to the technical accuracy of this description or our understanding of what the new method can accomplish. But without entering into a detailed explanation of the phenomena involved, it would probably be helpful to explain some of the terms which the lay reader encounters in press and magazine articles concerning frequency modulation and to venture a sort of "curbstone" explanation of how the reduction in noise is achieved.

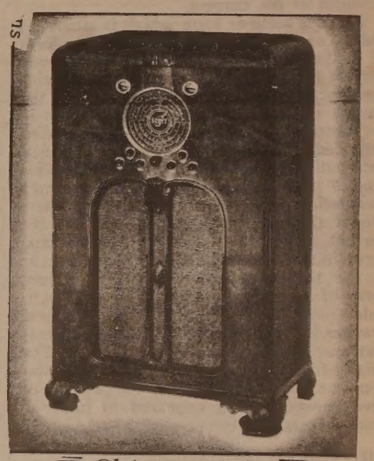
Radio transmission is accomplished by connecting an electrical pump (the transmitter) to a conductor known as an antenna, usually elevated above the earth, which pumps electricity into the conductor and sucks it out again hundreds of thousands or millions of times a second. Because of certain laws of nature, with which we need not concern ourselves for an understanding of the subject of this article, this process causes an exactly similar flow of electricity in conductors known as receiving antennas suitably placed within the range of the transmission, and this electric current flows up and down the receiving antenna the same number of times per second that the transmitting current flows in its antenna. The received current is weaker, of course, than the current in the transmitting antenna, being in fact a most minute replica of the current produced at the transmitting point. This weak current, however, is applied to a receiver, which amplifies it up to a strength where it may be detected and ob-

SCOTT RADIOS

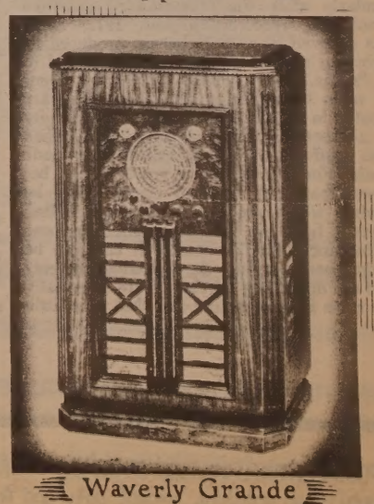
from SCOTT NEWS, January 1939



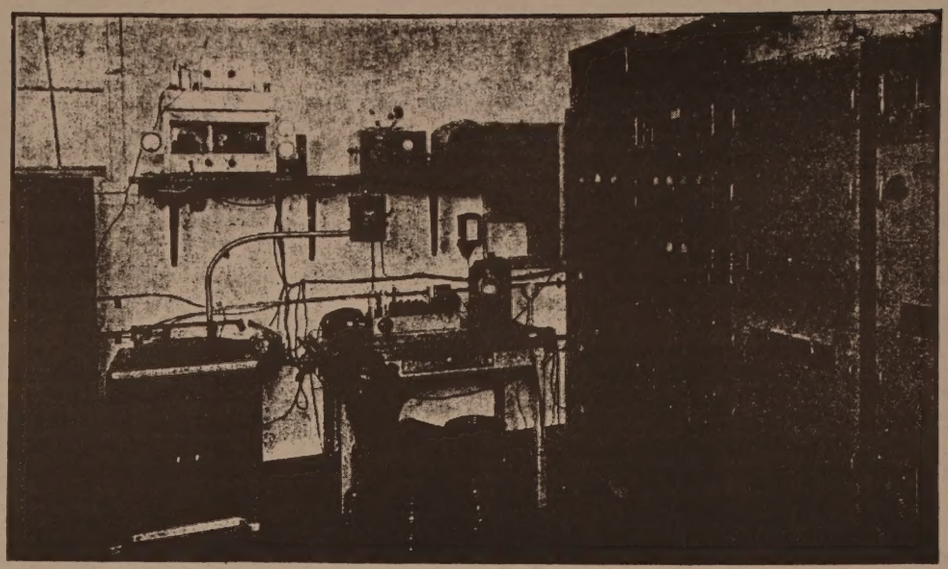
Warrington



Chippendale



Waverly Grande



Modulator for Transmitter at Major Armstrong's famous "FM" station at Alpine, N. J. The Major personally supervised the erection of the antenna and climbed up into the lofty mast himself to check the details.

served. This constitutes radio transmission, but not communication of intelligence.

In order to transmit intelligence it is necessary to perform some operation upon the transmitted wave so that this operation may be observed at the receiver. In the case of transmission of the spoken word, the process of impressing the voice, or molding it upon the transmitted wave, is called modulation. It has been standard practice to accomplish this by *varying the strength of the current in the transmitting antenna in accordance with the fluctuations of the voice.* This may be called strength, or, technically, "amplitude" modulation. The function of the receiving equipment is to translate these modulations into voice currents so that they may be heard in a telephone receiver or loudspeaker. In this type of signaling the speed of the pump at the transmitter is not changed during modulation; the electric current flows up and down the antenna the same number of times per second, regardless of the changes in the strength of the current.

There is another form which is almost as old as *amplitude* modulation. In this form of modulation the strength of the antenna current is not varied in any way; it remains constant. But the number of times that the electric current is pumped up and down in the antenna by the transmitter is varied (speeded up and slowed down) in accordance with the fluctuations of the voice. This type of modulation is known as *"frequency modulation."* At the receiving system, where similar changes in the number of times the current flows up and down the antenna occur in consonance with those which occur at the transmitter, a somewhat different form of receiving system from the amplitude modulation system converts these changes in frequency into the voice currents that may be heard in the loudspeaker. For twenty-five years this method of modulation was considered to hold no promise of development, and it appeared to have no practical use whatsoever.

THE PROBLEM OF STATIC

Ever since its earliest days, but particularly after the invention of sensitive amplifying receivers around 1912, radio has suffered from disturbances produced by lightning storms and commonly referred to as "static." More recently, with the advent of radio broadcasting where receivers are located in metropolitan areas in the vicinity of all sorts of electrical machinery, it has also suffered from so-called man-made static. For a good many years it was believed that some form of circuit could be devised which would separate the signaling current from the currents created by these disturbances, but eventually it came to be understood that both the signaling currents and the disturbing currents were essentially the same in their nature and that very little could be done to reduce their effect except to raise the power of the transmitting station; or, in the case of man-made disturbances, to place the receiving antenna as far away as possible from the source of the noise. Subsequently it was proposed to use frequency modulation, on the theory that these disturbances were essentially amplitude modulation and hence would be rejected by a frequency modulation system; but it was found that the disturbances contained frequency changes as well as amplitude, and very little improvement resulted. However, it was observed by the writer during the course of a series of experiments that these frequency changes appeared to be limited in extent to about the same changes in frequency as were being used in the frequency modulation system. The idea presented itself, therefore, that if the frequency changes in the signaling wave could be artificially increased in extent beyond those changes which existed in the disturbing currents, and a receiving system created which was immune to the amplitude modulated part of the static—feebly responsive to its small frequency changes but fully responsive only to the wide changes in frequency of the specially modulated wave—a means could be found for differentiating between the signaling currents and the disturbances. This proposal turned out to be a sound one and improvements of one thousand to one in noise reduction can now be readily produced in practice. Not only could this advantage be obtained, but, because the system operated most effectively in the ultrahigh frequency band, a further advantage over standard broadcast methods was secured as much less static was present in the ultrahigh frequency range.[1]

OPPOSITION TO THE SYSTEM

After many years of laboratory work to put it in practical form, the system was brought to the attention of the Radio Corporation of America and was demonstrated to its executives and its engineering staff. These demonstrations began at the end of 1933 and continued for almost two years, at the end of which time the Radio Corporation declined to undertake the task of putting the system into public use. Various reasons were advanced to prove the impracticability of the system, such as its alleged inability to work beyond the horizon, the necessity of constructing new transmitting stations, and the high cost of new receivers. The proposition was also advanced that if amplitude modulation was used in the ultrahigh frequency range, substantially the same freedom from noise could be secured, as well as the same quality of reproduction. Subsequently, when the better quality of frequency modulation was demonstrated, the proposition was advanced that the public would not appreciate it and did not want it.

Still later, when a phenomenon was encountered in television transmission in large cities, which resulted in multiple images (ghosts), it was stated that frequency modulation transmission could not avoid a similar type of distortion.

The proposition was also advanced that the system was wasteful of channel space in the radio spectrum and that if ultrahigh frequencies were ever used in broadcasting the amplitude method of modulation would be more economical thereof.

The writer, disagreeing with all these conclusions, undertook the burden of introducing the invention to the public and started the construction of a high-powered station whose success or failure would take the matter out of the realm of academic discussion. As it was essential that the performance be so outstanding that any "talk down" campaign would be silenced, the station was designed to have a power ten times greater than ever before produced at ultrahigh frequency. A site was selected at Alpine, New Jersey, some seventeen miles north of New York City, and construction was started. Meanwhile an amateur station, W2AG, located in Yonkers, New York, owned and operated by C. R. Runyon, was equipped with the frequency modulation system. The performance of this station disposed of many of the bugaboos so cheerfully predicted for frequency modulation. After witnessing the demonstrations, the Yankee Network management, operators of a chain of stations throughout New England, and the owners of Station WDRC in Hartford, Connecticut, became interested and started the erection of stations in Paxton, Massachusetts, and Meriden, Connecticut. This entry into the field by two successful broadcasting interests, and the demonstrations which were carried out by the Yonkers station, stimulated a dozen or more enterprising broadcasters to secure construction permits and to start the erection of transmitters. The importance of the part played in this development by Mr. Runyon's station can hardly be overestimated. During the three-year period prior to the Alpine station's completion, scores of demonstrations were made to representatives from all branches of the radio industry, who were given every opportunity to examine the system's performance. No one was refused the opportunity to observe the operation under all conceivable conditions.

It was possible with very little vision to extrapolate this comparison between a 500-watt frequency modulation station and the 50,000-watt standard amplitude modulation broadcasting station, and to forecast what the service of the Alpine station would be like. There were a few enthusiastic disciples as a result of some hundreds of demonstrations.

The performance of the Alpine, Paxton, and Meriden transmitters convinced the broadcasting industry that a change was inevitable, and approximately 150 applications were filed with the Federal Communications Commission. Since the frequency allocation assignment made no adequate provision for this number of stations, in the fall of 1939 the Commission suspended the granting of experimental licenses in order to review the situation and to consider the point which had been raised by the Radio Corporation of America that the standards which were being used were not the best. After a hearing held in March of 1940 the Commission approved the standards which were then in use, removed the experimental limitation, arranged to issue commercial licenses as of January 1941, and reallocated a part of the frequency spectrum to increase several-fold the channel assignments for frequency modulation. The lower frequency part of the assignment to television, which had not fulfilled the early predictions of its readiness to furnish a public service, was rearranged. Nineteen channels had been assigned to television. Each television channel was sufficiently wide to accommodate 30 frequency modulation stations. The lower or Number 1 television channel was assigned to frequency modulation and the two lower television channels moved progressively upward, the new Number 1 occupying the old Number 2 position and the old Number 2 moving up into a space previously allocated to government use. This action by the Commission was taken in May 1940, and the art prepared to move forward.

The enthusiasm over the quietness of the reception was as expected, but the most gratifying result has been the response to the improved quality of transmission. The point had been made, and in some quarters was strongly urged, that the public would not appreciate so-called "high fidelity" reception; in fact, that it did not want it. This contention was supported by reference to the public reaction which attended the introduction of standard broadcast system receivers which had a wider range than the usual 5,000 cycles. One or two attempts had been made to create a market for receivers whose frequency range extended up to 7,000 or 8,000 cycles. It was found that these receivers did not sell well, and when they were sold the listener made rather drastic use of the tone control, which prevented the higher frequencies from being reproduced. Hence it was concluded that the public, from some impairment of its sense of aural perception, did not want the higher frequency range. Quite the reverse, however, was the case. What the average listener objected to was not the increased range of the frequencies reproduced, but the pres-

[1] The ultrahigh frequency range may be considered as below 10 meters (30,000 kilocycles).

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ence of certain harmonic distortions which are particularly offensive in the upper frequency ranges. These tones, together with the increased noise which always attends the extending of the frequency range, were the things which were really being rejected. When the harmonic distortions and the noise were removed from the signal by means of the frequency modulation system, the full frequency range was instantly appreciated. The reproduction then became natural. It is difficult now for one to credit that the contention was actually made that an unnatural type of reproduction was to be preferred to a natural one.

WIRE-LINE FACILITIES

At the present time only one obstacle stands in the way of a full realization of the advantages of frequency modulation throughout the country, and that is the limitation upon network operation imposed by the deficiencies of wire-line connections. These connections as at present set up are limited to the transmission of a frequency range up to 5,000 or 6,000 cycles, with a residual noise level considerably greater than that required for the full dynamic range of studio orchestral productions. This limitation does not, of course, affect the static-eliminating qualities of the system, but would reduce the quality of the transmission to that imposed by the characteristics of the wire lines. Some improvement may be expected in these characteristics, but they will probably not be set up to carry the full frequency range for a long time to come. There is, however, a relatively simple solution which is now in use in New England. By means of *radio relays,* Boston, Paxton, and Mount Washington have been successfully linked together, and within the coming year it should be possible to extend this circuit to include New York,** so that no wire-line facilities whatever will be required. No major technical difficulties are likely to be encountered.

Edwin H. Armstrong was associated with Professor Michael I. Pupin in research at the Marcellus Hartley Research Laboratory of Columbia University, 1914-1935; served as Captain and Major in the Signal Corps of the United States Army, 1917-1919; and is the inventor of the regenerative circuit, the superheterodyne, the superregenerative circuit, and a method of eliminating static in radio by means of frequency modulation.

While it may be possible ultimately to obtain the same technical performance by the use of the coaxial-cable method of transmission, there will be large sections of the country where it is not economically feasible to use this, and where it cannot compete with the radio relay. This is particularly true in the mountainous sections of the country. The establishment of regional networks entirely radio connected, extending throughout large sections of country of this type, is entirely practicable, and several such projects are now under way. Very rapid development in the radio relaying field may be expected.

Looking at it from the standpoint of the broadcaster, it is easy to see that the lower cost of the transmitting equipment, its economies of operation, and the possibility of the reduction of wire-line costs by the use of radio relays, are all in his favor. For the manufacturer of transmitters, and more particularly for the manufacturer of receivers, there lies a vast new market in an industry which has unquestionably reached a saturation point. Superficially, one might be led to believe that the industry would welcome a development such as this, but the fact remains that, with a few exceptions, it has not been welcomed by the large units of the industry. The burden of the development has been carried almost entirely by the smaller units. The reasons for this opposition are quite obscure, but nonetheless they are very real ones. It is important in the interest of the future progress of the radio art that at some time they should be brought out into the light of day.

PRACTICAL APPLICATIONS

In this article, the application of the frequency modulation system to the *broadcast* service has been treated. This is, of course, its major application. There are, however, applications to numerous other services, and the field is widening almost daily. At the moment, the greatest activity is in its application to the emergency services, particularly to the police service.

The largest project at the present time is that undertaken by the Connecticut State Police, who have in operation nine fixed stations and approximately two hundred mobile stations equipped for two-way operation with the fixed stations and with each other. The installation has been completely successful and the State is effectively covered.

The next largest project is in the City of Chicago, where some two hundred mobile units are in process of installation. Numerous other projects for police service and for emergency use by the power companies are being put forth, and it is doubtful whether many new installations employing amplitude modulation will be made in the future. It is, of course, needless to say that there are many important military uses; and its application in the field of aircraft appears to be a promising one.

The one important field in which progress has been inexplicably slow has been television, where its advantages, particularly on the sound channel, could be effectively utilized at once. A limited use has been made of frequency modulation for the relaying of the television sight channel.

In recent years it is only in the broadcast service where interstation interference has caused serious difficulty, and now this situation is likewise about to be cleared up. If in the future the demand for broadcast channels exceeds the facilities of the channel space now practically available, the engineering world is prepared to open up new bands in that space technically known as the ultrahigh and micro-wave region where the ratio of the unused channel space compares to that now in use as the unsettled to the settled parts of the earth. The trend of radio inevitably will be upward into the higher frequencies.—*Reprinted by permission from The Annals of The American Academy of Political & Social Science.*

**This Plan for the FM Relay Network, which includes New York City was carried out successfully during the past year. The advantages of frequency modulation transmission for relaying purposes was manifested when the programs were received without any noise or distortion, after having been relayed several times. Such noise-free, distortion-less transmission of voice and music cannot be duplicated by existing wire telephone lines.

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(NEW YORK TIMES REPRINT)

Recalling the Joy of Watching Baseball on the Radio

By MARK HARRIS

For almost everybody, a game of professional baseball was an image before it was a reality. We heard about it before we saw it. Depending on the year of our birth, it came to us first as a voice through the air into that blind box we called radio. Or it came to us in more recent decades as figures moving on a screen that, in its early stages (I'm remembering the Yankees and Dodgers in the World Series of the early 1950's), often appeared to be men gallantly struggling through a snowstorm.

In time the picture was fine-tuned or cabled, the snowstorms ended, color was introduced and the visual transmission of the game equaled any dream we could have generated out of mere imagination. This perfect colored clarity was known as television.

Is television better than radio? Each instrument brings a different kind of satisfaction. Each has different uses and emphases. When radio was all we knew, it was good enough, marvelous beyond telling. One set oneself up with

the scorepad and beverage and followed the action without the slightest sense that he was somehow deprived by the fact that he was following something he could not see.

Indeed, he may have seen it better, for he saw it in the stadium of his mind, where nothing intervened, free of the limitations of realism. I saw very vividly in 1932 Babe Ruth's pointing to the fence, hitting the ball over it, and thereby crushing the Chicago Cubs and every National League fan. I saw very vividly, my head poked through the open window of somebody's automobile, the first All-Star Game ever played, when Carl Hubbell for the National League mowed down by strikeouts five American Leaguers in succession.

Of Playback and Slow Motion

It does not now occur to me that I did not literally see those things. I saw them as truly as I saw Dave Parker in the 1979 All-Star Game make his remarkable game-saving throw from right field: saw Parker make his throw not once, not twice, but half-a-dozen times at least by the miracle of instant playback and slow motion. Of playback, nobody had ever heard in 1933. And life itself was slow motion.

The family radio was a luxury, a big item; it occupied a place in the house in the space now reserved for television. A boy of radio days aching to know the score may not have owned a "portable radio." He was pleased enough if somebody posted the line score somewhere outside a shop or hanging on a banner from a window. It was knowledge in depth to know who was pitching, who hit a home run. "How did they get those two in the third inning?" one asked, and someone told how, perhaps accurately, perhaps not.

For details, the fan was required to wait for the 7 o'clock sports resumé, delivered once upon a time by a fast-talking sports announcer named Ford Frick, who signed off with "Adios" and rose to become nobody less than the Commissioner of Baseball. The newspapers carried line scores, but they were often incomplete regarding games in the West (St. Louis, Chicago), and sometimes one went to bed ignorant of outcome, forced to wait for the morning newspaper to tell him who had won and how.

Most of us who are interested in the baseball results choose to watch on television in preference to radio. Some purists among us contend that they watch best by following the television ure and the radio voice — I appreci- that. And a few people scorn televi- for radio altogether on the ground that the more we see with our eyes the less we truly see in that stadium of the mind where the best excitement dwells.

Radio left things to the brain, to the imagination and to fantasy. On radio we saw the whole baseball field because we saw it in our minds through wide-angled fantasy. We knew no limits upon our vision. We were our own camera. Pictures arose in our imaginations from the merest hints of things. Our minds were tubes that seldom blew.

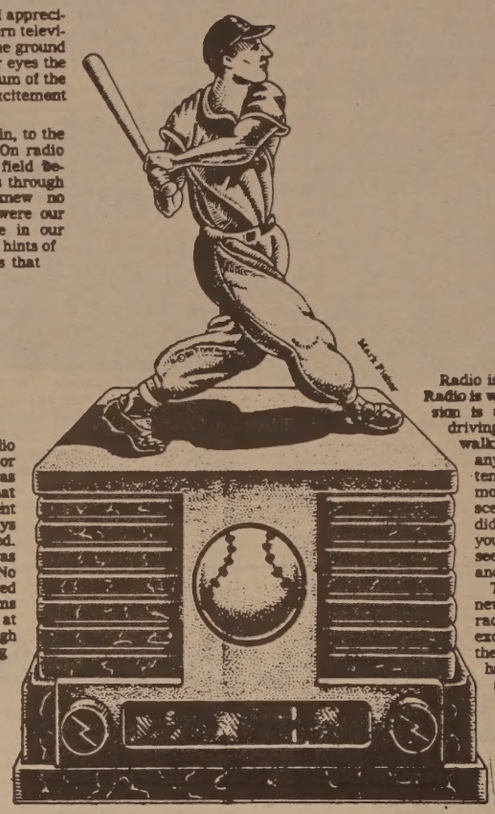
This is not to say that radio was better than television, or that one age of mankind was better than another. But that radio was significantly different from television, and not always less efficient, cannot be denied. Radio was awe. The awe was produced by remoteness. No baseball player ever entered my house by radio, as he seems to do by television, staring at me in my own rooms through the eye of the camera, telling me quietly in his soft-spoken voice, through the mediation of an interviewer, how things have been going with him. Television reduces awe. In the days of radio, we scarcely knew the faces

of the players, and so they were gods in ways the modern player can never be, whose face is familiar to us; whose stance and style we so clearly see; who sweats, who spits, who tugs at his crotch; whose tight-fitting uniform in living color reveals his merely mortal form.

Television subsidizes baseball. Radio, of course, never did. Exposed to millions of eyes at any given moment, the baseball player is implored by his industry to behave like a gentleman. He is not only visible but tame, and he and all television sports announcers are remarkably precise in describing his skills. When radio was alone in the field, it provided a different order of excitement. It gave sound and language to the fantasies of boys who not only played the game but announced their own actions in the voice of radio.

"This is your neighbor Bobby Smith Junior at the plate, folks, look at those muscles, here comes the pitch . . . . ," — and there it went, powered by the voice of the radio announcer. The announcer was the key. He was the whole show. He supplied excitement at a level the television announcer can never achieve, for the voice of radio was free to tell it not as it was but as he cared to dramatize it. The world was his. He was describing things his listeners could not see, nobody could check him out; he made a crowd of 900 fans sound like 50,000 with tricks of his trade.

Indeed, some baseball announcers in radio days compellingly told play-by-play games they no more saw than you or I. These marvels of communication were somewhere along the line described as "re-creations," but that was



a word you almost never heard above the recorded noise.

And yet, without doubt, almost all of us watch baseball games on television, which we prefer to the particular kind of excitement radio offered. Television is a partial view. Yet we choose it. Proprietors of television drama tell us of the terrible dangers of "two heads talking," and yet baseball games on television are largely two heads playing — the batter, the pitcher. Behind the batter crouch or stand two men whose heads are masks. Mesmerized, hypnotized, we do not demand of television that spacious view of the ball park that radio gave us by the act of suggestion, to which our blind imaginations responded. On television we see the whole arena infrequently from the height of a blimp, but when we see from such a height, we see few details; you can't watch a ball game from a blimp.

Radio is a supplement to television. Radio is what you listen to when television is unavailable; when you are driving your car, tending shop, walking the street, bathing; at any moment when you can listen but cannot look. It is at such moments that you must set the scene for yourself, as everybody did in radio days, carrying in your mind things you cannot see: how many men are on base, and where.

The old form imitates the new, and wisely. The voices of radio are no longer the voices of excitement, as they were when they were the *only* voice. They have modulated themselves, striving to be informative, as if they know that they are only holding actions; you will tune them out as soon as you can get to a TV set.

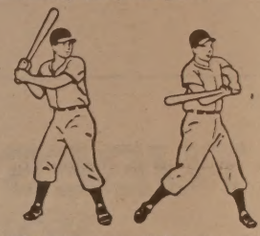
The voice of radio came to us in duet with a roar of the crowd, but radio can no longer hold us on a plateau of indiscriminate excitememt. Television has abolished the mindlessness of continuous excitement. Think of women! Most women never required the fantasy of radio because they seldom played baseball; were never ambitious along baseball lines, and were discouraged, as many men were, by the insanity of the radio announcer's sustained excitement.

Fans are released to see for themselves the reason and symmetry of the game. As in all drama, baseball's moments of supreme excitement are periodic, not continuous. Not the announcer's excited descriptions of fine plays, but the sight of fine plays increase appreciation of the idea of baseball and develop its audience. Radio conveyed excitememt. Television brings an accurate, hard image out of which everyone may make his own excitement at beckoning moments.

In television the voice of the announcer is not so much provocation to excitement as background to the action. The announcer does not excite us, he informs us. Our eyes now see that scene our fantasies created in the days of radio. Our vision forces modesty, silence and discretion upon the television announcer; only a fool dares to describe what we can see for ourselves.

History has ordained that the pattern of broacast baseball follow from excitement to information. Radio served the fantasizing fan; television serves the viewer watching the game for himself. This being so, little wonder that baseball has moved from a focus upon heroes and myths toward an obsession with its finances and feuds.

Television is closeup. In politics and in warfare in recent years television has cast a cruel but salutary light upon realities. Baseball is neither war nor politics, and whether it required the cruel light of television I do not know. But we may be better off than we were for its having brought us closer to an understanding of the way the game is played afield, and the way it is played by the men and women at every level of enterprise. Truth is better than fakery, and we are better off for having come to the end of the spurious excitement that was radio at worst. We are free to enjoy the act of observing for ourselves the real rhythm of the sport.



Of course, some of the voices of television may irk us, even as some of the voices of radio do. But observers of baseball have options for a kind of excitement different from the excitement of 1932, 1933, the 1950's, days of radio, days of snowstorm television. The voice of the television announcer is low. The voice of radio was shrill, fast. The voice of television is cool. The voice of radio was high and hot.

Mark Harris is the author of "Bang the Drum Slowly" and other Henry Wiggen baseball books. His most recent book is entitled "Saul Bellow: Drumlin Woodchuck" published by the University of Georgia Press.

'Which shall we take, the car or the wireless set? We can't take both.'

SERVICING ATWATER KENT SPEAKERS

General Description

1. Horn Type

The sound unit of the Atwater Kent horn type speaker consists of a powerful permanent magnet similar to a horseshoe magnet, mounted at the end of a short cylindrical metal chamber. The two poles of the magnet have extension pieces, each of these being wound with a coil of very fine wire. These two coils are connected in series and also thru the speaker cable and plate circuit of the last tube of the radio set.

A diaphragm in the form of a circular disc of special alloy metal, carefully mounted between rubber gaskets, is suspended so that its surface rests but a small fraction of an inch above the extension pole pieces of the magnet.

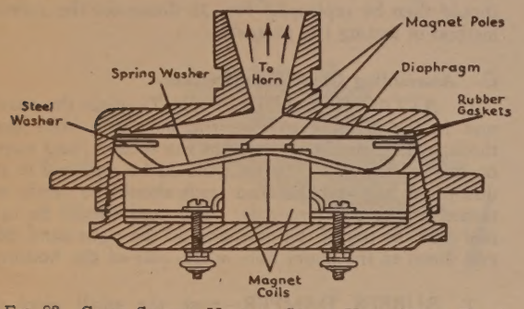


FIG. 83. CROSS SECTION VIEW OF SOUND UNIT (HORN TYPE).

The action of the unit is as follows:—When a radio signal enters the receiving set, as explained under Section I "Theory of Radio Receivers," it causes fluctuations or changes in the flow of current in the plate circuit. Since the magnet coils of the speaker unit are in series with the plate circuit, these changes in current will pass thru these coils, and this in turn will cause variations in the pull of the permanent magnet on the diaphragm. Accordingly the diaphragm vibrates, and in doing so, causes sound vibrations which pass thru the air column of the horn into the room to the listeners' ears, an almost perfect reproduction of the sound at the microphone of the broadcast station.

2. Cone Type (Models "E" and "E-2")

The Models "E" and "E-2" Speakers are of the "free-edge" cone type, and differ in many respects from other cone speakers on the market.

The magnet is a powerful double one, and the vibrating element a thin rectangular reed of special alloy steel, mounted so that one end can vibrate freely between two of the four poles of the magnet. A single magnet coil is mounted so as to surround and enclose the reed without touching it, and the current in the plate circuit of the radio set passes thru this coil.

The apex of the cone is attached directly to the reed by a novel spring mounting which supports the weight of the cone, but at the same time allows it complete freedom of motion.

As in the case of the horn-type speaker, the changes in the current from the set passing thru the coil of the speaker unit cause changes in the pull of the magnet on the reed, thus causing the reed and the cone attached to it to vibrate correspondingly. The cone vibrates the air directly, giving very lifelike reproduction.

Comparison Test

When an Atwater Kent speaker seems to be functioning imperfectly, it should first be tried out on reception in comparison with a speaker of similar type that is known to be good. If this comparison definitely indicates that the speaker is defective, it should be inspected and tested to determine the source of trouble.

Damaged Coil or Cord

If the speaker does not work at all, the trouble may be in an open magnet coil or an open cord. These may be tested with a voltmeter and battery. If the cord or the coil circuit is open, no reading will be secured on the meter. If the cord is damaged, or the connections half-broken, the meter will usually give an erratic reading when the cord is shaken.

In testing the coil, the voltmeter test points should be applied directly to the coil terminals on the sound unit. If the coil is open, the sound unit should be replaced. If the cord has an open lead it may sometimes be repaired satisfactorily, otherwise it should be replaced.

Detailed Service Information

1. Horn Type (including phonograph attachments)

A. Disassembling Horn Unit.

Remove gooseneck and horn from base of speaker, invert base and unscrew knurled cap all the way. Lift

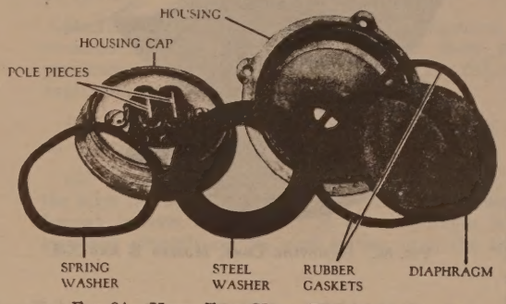


FIG. 84. HORN TYPE UNIT, DISASSEMBLED.

out the bronze retaining spring, then the steel washer and the rubber gasket, then the diaphragm and second rubber gasket at bottom. These parts are indicated in Fig. 84.

B. Testing.

Test the coil and cord for continuity and then carefully inspect the other parts, looking for the following.

C. Possible Troubles.

1—Iron or other foreign particles on pole pieces. (Sometimes these particles are so small as to be hardly visible).
Remedy:—Pick off with a small sharp knife, working outward and upward from between the pole pieces.

2—Diaphragm bent, buckled or up-side down.
Remedy:—Replace diaphragm or assemble correctly.

3—Weak spring. Spring may give insufficient pressure against diaphragm, causing rattling on very loud signals.
Remedy:—Replace spring or bend so as to increase height of all four of the bends, making them all exactly the same height.

4—Rubber gaskets. If these show signs of deterioration they should be replaced. If new gaskets are used in reassembling the unit, each should be stretched to fit tightly in the housing. This may be done by holding the gasket by both forefingers and expanding it for a moment to a length of about eighteen inches, repeating this three or four times.

5—Weak magnet. Test with weight-scale in the following manner:

D. Testing Magnets in Horn Type Units.

Equipment for testing the strength of the sound unit magnet is very simple and inexpensive, consisting of a small spring-type weight scale, about 0-10 pounds,—(which may also be used in testing the cone type sound unit magnets) and a circular flat disc, ground absolutely flat, of soft iron (Swedish or "Armco" iron) about 1 inch in diameter and 1/16 inch thick. This disc should have a small central stud, carrying a hole, attached to the center of one of its sides. A loop of strong flexible string, about an inch or two in length, should be attached to the hole in the stud.

To test the strength of the magnet in a horn type sound unit, place the flat side of the disc centrally on the pole pieces, loop the string over the weight-scale hook and carefully exert a steady pull exactly along the axis of the unit until the magnet lets go. The position of the speaker and scale is shown clearly in the accompanying illustration, Fig. 85.

When pulling on the horn type sound unit, the disc "armature" should not be released until the scale registers a pull of about 4 pounds or more. Assuming that the weight-scale has been checked for accuracy, if the reading is appreciably less than 4 pounds, and if the speaker is noticeably weak in actual reception, the sound unit should be replaced.

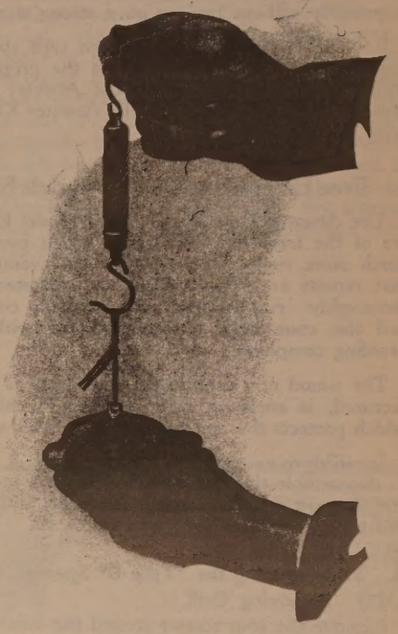


FIG. 85. TESTING MAGNET STRENGTH, HORN TYPE UNIT.

With time and use there is some unavoidable loss of magnetism in speaker magnets. But in general this decrease does not appreciably affect the performance of the speaker, so in all cases the final test should be in listening to actual reception. The magnetic strength tests are chiefly of value in eliminating one possible source of trouble.

After the unit has been carefully examined and tested, and any defective parts repaired or replaced, it may then be reassembled.

E. Assembling Horn Type Unit.

(1) RUBBER GASKET—place in its groove in housing and use the steel washer to press the gasket into place. The gasket should not fall out when the housing is inverted and shaken. The steel washer should, of course, be removed.

(2) DIAPHRAGM—center on the rubber gasket with the concaved side toward the horn. It is very important that the diaphragm should be placed with the concaved or hollow side facing the horn opening. Instructions to this effect are rubber-stamped on the concaved side of each diaphragm. Also it is extremely important that the diaphragm should be centered perfectly on the rubber gasket and that it does not touch the metal housing at any point, otherwise the diaphragm will rattle.

(3) RUBBER GASKET—place over the diaphragm and press into position with the steel washer, taking care not to disturb the diaphragm setting.

(4) STEEL WASHER—place over the rubber gasket with the concaved or hollow side facing the diaphragm. The concaved side of the steel washer may be found by laying a straight edge across the face of the washer and holding both up to the light.

(5) BRONZE SPRING WASHER—place in housing over the steel washer.

(6) HOUSING CAP—screw clockwise on housing.

F. Adjusting the Horn Speaker.

The speaker should be adjusted during reception of a strong and clear broadcast station. Screw up the knurled housing cap clockwise until the diaphragm snaps against the pole pieces, causing reception to become weak and rattling. It should then be unscrewed until a click occurs and reception comes out clear and normal, the best adjustment being as close (turned clockwise) as possible without rattling on a strong signal.

It is necessary to have the horn type speaker leads connected to the receiving set in the proper manner, which is clearly specified on the Atwater Kent horn type sound units and also on the Atwater Kent battery-type radio receivers.

2. Free Edge Cone Type (Models E and E-2)

The Atwater Kent Model E and Model E-2 Speakers are of the free edge cone type. Their construction is much more rugged than that of the average cone, so that repairs are seldom required. All steel parts are thoroughly rust-proofed, and both the coil windings and the cone itself are impregnated with moisture-proofing compound.

The sound unit used in these speakers as now manufactured, is enclosed in a dust-proof rubberized bag which protects the unit from iron particles and dust.

In order to examine and test the parts, it is necessary to disassemble the speaker. Instructions for doing this and instructions for testing, repairing and assembling this type of speaker are given below.

A. Disassembling the "Type E" Speaker.

(1) Removing Grill.

Remove the four screws around the outer housing of speaker, then remove the front (grill) in this way:

Stand the speaker on a firm table, place a double fold of heavy cloth over the top of the grill of the housing, hook the thumb of the left hand under the top edge of the grill, with the other fingers of the left hand pressing down on the top of the housing, and then, through the cloth, hit the top of the edge of the grill several sharp blows with a hammer, at the same time pulling forward with the thumb. The vibrational effect of the hammer blows tends to loosen the grill from the housing, while the steady pull with the thumb tends to move the grill forward and off the housing. The cloth is used to protect the finish of the grill, which would otherwise be marred by the hammer blows. In removing the grill, be careful not to let it hit against the cone.

(2) Removing Cone.

The cone is attached to the flat reed spring by a small bolt and nut. Two special wrenches (Part No. 9255) should be used in removing this bolt, the illustration, Fig. 86, showing how this should be done. Hold the cone by the small metal bracket at its apex and pull straight off from the reed spring.

(3) Removing Sound Unit.

The sound unit is removed by unscrewing the two acorn nuts at the rear of the housing. Note how the cord is brought over the top and in back of the sound unit down to the small hole at the rear of the housing. When assembling the speaker, the cord should be arranged in the same way. In handling the sound unit be very careful not to strain the flat reed spring.

B. Possible Troubles.

1. OPEN COIL OR CORD—test with voltmeter and battery for continuity. Replace if found defective.

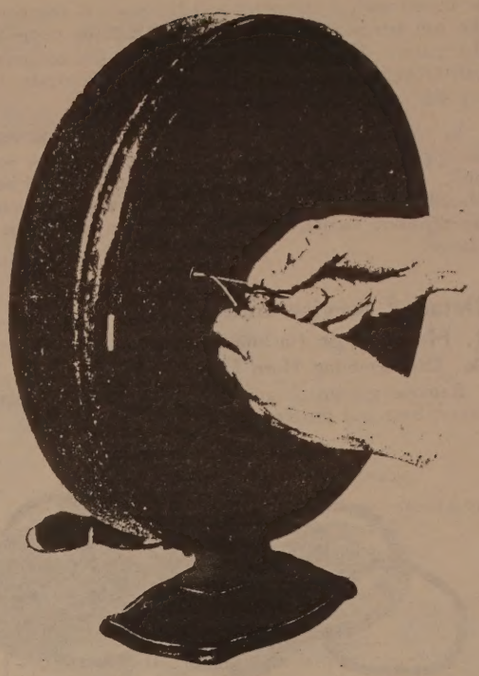


FIG. 86. REMOVING CONE, MODELS E AND E-2.

2. DAMAGED CONE—examine carefully for cracks and bends, especially around the apex. If no defect is found, hold the cone horizontally with hollow side up about 3 or 4 inches above a firm wood-topped table and then drop so that the apex will hit the table. If the cone is in satisfactory condition it will strike with a clear resonant "knock" rather than a dull, lifeless thump or thud. Replace cone if it seems to be defective.

3. METAL CHIPS ON POLE PIECES—carefully remove the dust-proof bag from the sound unit and examine the air-spaces between the reed and pole pieces to determine whether iron or other particles (caught up by the attraction of the magnets) are clogging up the air-spaces between reed and pole pieces and consequently interfering with free motion of the reed. If such a condition is found, it is sometimes possible to remove the particles, although usually it is advisable to replace the unit.

4. IMPERFECTLY ADJUSTED SOUND UNIT—examine the sound unit to see if the reed is adjusted centrally between the pole pieces so that the air-spaces at each side are equal. If the reed is not centered correctly, the unit should be replaced, although in exceptional cases a qualified service man may adjust the reed.

Adjustment of the reed is made through the two screws which pass through the magnet and bear on the reed. By loosening one screw and tightening the other, the reed may be moved to either side. When the reed has been adjusted exactly to the center the two screws should be tightened alternately little by little, until both are tight.

The adjustment may be tested by clasping the reed spring, near the reed, between the thumb and forefinger and pushing and pulling so as to cause reed to snap against either pole piece. The same force should be required to move the reed in each direction. If the unit is properly adjusted see that the air-spaces are free from chips and then carefully replace the dust-proof bag.

5. LOOSE NAME PLATE OR SERIAL PLATE—Suspend the grill by one hand and with the wood handle of a screw driver sharply tap the grill near the name plate. Listen carefully and if a "tinny" noise is heard, the name plate is not fastened securely and should be tightened by hammering down the holding tabs. Do the same with the serial plate on the back of the housing.

6. WEAK MAGNET—The testing outfit for determining the magnet strength is identical with that used for the horn speaker, except that instead of the flat disk a U-shaped bar is used. This bar must be accurately made so that when suspended, inverted, from the scale, its inside circumference clears the coil winding and the ends of the "U" rest flatly one on each magnet pole, lying clearly within the permanent magnet by about 1/64" on each side. It will be found more convenient to use the front or cone side of the unit for this test.

The dimensions of the bar are—width 3/8", thickness 3/32", diameter (over all) 1-3/16". If a straight pull of less than about 7 pounds will separate armature from magnet, a weak magnet is indicated and the unit should then be replaced. Fig. 88 illustrates the correct method of testing the magnet.

C. Assembling Cone Type Speaker.

1. ATTACHING SOUND UNIT—place the sound unit in the housing so that the mounting bolts pass through the holes in the back of the speaker, and screw on the acorn nuts. The unit should be enclosed in its dust-proof bag and the cord leads should be firmly attached to the coil terminals. The cord should be carried over the top of the unit, around the right-hand side and down to the outlet hole in the rear of the housing.

2. RUBBER DAMPER—push the small piece of rubber tubing on the flat reed spring, bringing it close to, but not touching, the unit.

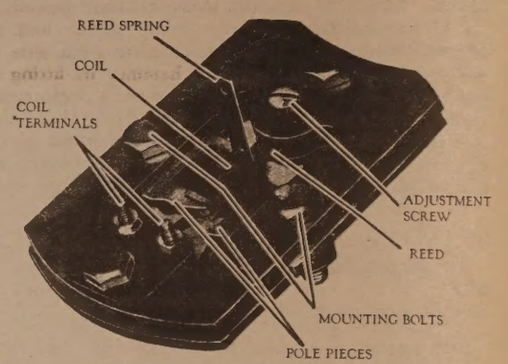


FIG. 87. CONE TYPE UNIT.

3. MOUNTING CONE—push the metal bracket at the apex of the cone on to the flat reed spring and push the small screw thru holes. Screw on the nut but do not make it very tight.

With the two special wrenches (part No. 9255) on this small nut and bolt, tip the cone up or down so that its top and bottom edges are equally spaced from the housing, then carefully tighten the bolt. If the cone moves out of position, the bolt must be loosened and the cone again adjusted until the top and bottom edges are equally spaced from the housing when the bolt is fastened tightly.

Then examine the right- and left-hand edges of the cone to see if they are equally spaced from the housing. If they are not, use a pair of pliers to bend the reed spring very carefully and easily toward the side of the cone that is too close to the housing. When the spring is released it will be found that that edge of the cone is now spaced farther from the housing. Repeat this process until the right- and left-hand edges of the cone are equally spaced from the housing. The spacing between the edge of the cone and the housing should then be even all the way around. (In bending the reed spring, hold the pliers horizontally and grip the end of the metal bracket which fits over the reed spring. The best tool for this purpose is a parallel-jaw pliers, 3/8 inch wide, with the ends slotted to fit over the bolt and nut.

FIG. 88. TESTING MAGNET STRENGTH, CONE TYPE UNIT.

Speaker in Model 52 Set

The speaker in Model 52 receiving set is of the "held-edge" type, somewhat like Model E-3. The flexible edge of the diaphragm is pressed all around between the housing flange and a large fibre ring.

To remove speaker, release cord tips from speaker posts on set, rest cabinet on its back, take out the six screws holding the speaker and draw out the speaker, fibre washer and grill.

An inspection of the speaker will then show that the diaphragm is mounted on the reed spring in the same way as in Models E, E-2 and E-3, with the exception that the edge of the diaphragm touches the metal flange all around.

Instructions for disassembling, testing, repairing, and re-assembling this speaker are similar to those given previously for the E, E-2 and E-3, with the following explanatory remarks:

(1) The small rubber reed-spring damper is not used on this model.

(2) In mounting the diaphragm, make certain that the edge of the cone (where it is joined to the flexible fringe) is level all around. If the diaphragm is not mounted properly on the reed spring, or if the spring is bent, the edge of the cone will extend up on one side and be depressed on the other. The remedy is the same as given above under the heading "Mounting Cone."

(3) The speaker is mounted in the cabinet with the outlet hole for speaker cord nearest the top, or set. The speaker cord is brought down and under the sound unit and up to the outlet hole.

(4) When replacing the speaker, put the fibre ring on top of the diaphragm, lining up the holes in the ring and those in the diaphragm and housing flange. Then place the wire grill on top of the fibre ring in such a way that, when mounted upright in normal position in cabinet, one set of equally-spaced grill wires will be horizontal and another set of equally-spaced wires will be vertical. (See paragraph immediately above.) Rest the cabinet of set on its back, and (for convenience of mounting) temporarily place a screw through the left hand hole in the housing flange, fibre ring and grill, with the head of screw toward the back of housing. Arrange the speaker in cabinet so this screw comes up through the left hand hole in front of cabinet and place a nut on this screw, meanwhile holding the speaker in place with one hand. Put in the other five screws (with the heads on outside of cabinet), remove the first screw and replace it properly.

The slot should be about 7/32 inch wide and ¼ inch deep.)

4. REPLACING GRILL—Rest the speaker on its back and press the grill on to the housing, taking care to see that the screw holes coincide and that the grill is placed with the name plate right side up. It may be necessary to use a hammer in fitting the grill on the housing and, in this case, as before, a thick cloth should be used to protect the finish of the grill from the hammer blows. When the grill is in place, replace the four screws which hold it to frame.

3. Model E-3 Held-Edge Cone

The manner of disassembling, repairing and assembling the E-3 is exactly the same as for the E and E-2.

The cone of the Model E-3 speaker has a flexible rubberized fringe extending beyond the edge of the cone. Before the grill is placed on the housing, the cone and fringe are clear of the housing, with equal spacing all around between the rubber fringe and the housing. The grill has a strip of felt around its inside edge, and when the grill is pressed down on the housing, the outer edge of the rubber fringe is pressed tightly between the edge of the housing and the felt strip in the grill.

The small rubber damper is not used on the Model E-3 speaker.

just occurred to me—perhaps there was nothing on'

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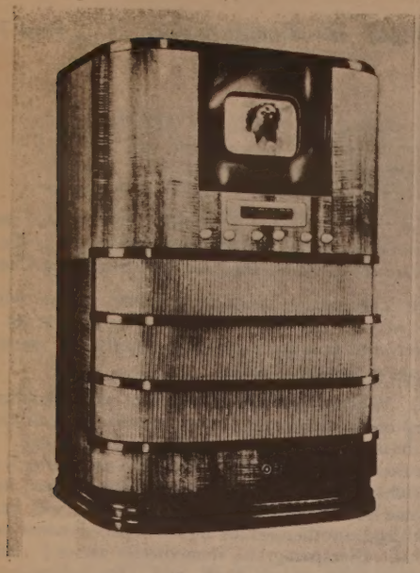
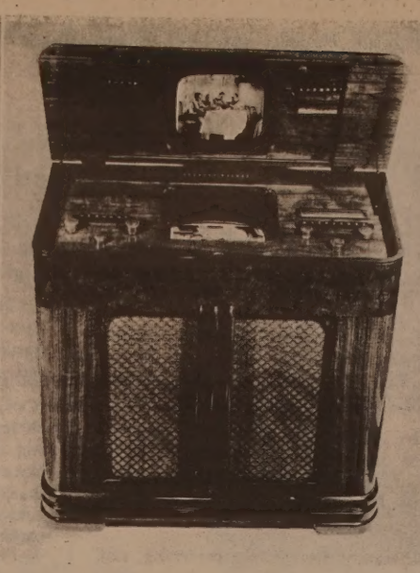
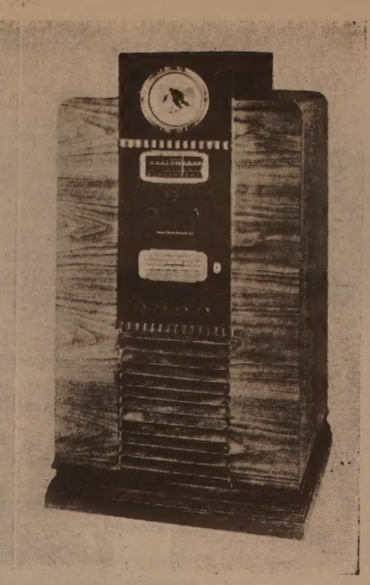


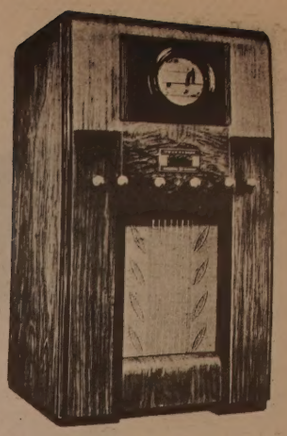
29-tube General Electric model HM-226 television set with 12-inch tube and all-wave radio.



Stewart-Warner television set with high-fidelity sound channel. Uses 12-inch picture tube.



Videor receiver by American Television with 5-inch tube and 3-band sound unit.



18-tube General Electric model HM - 185 with 5 - inch tube.

A fine group of 1939 television sets.

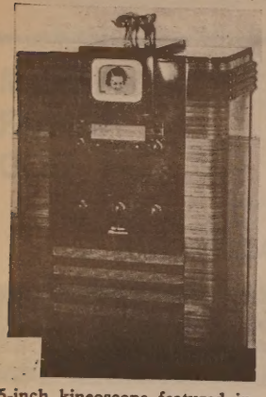
Television Receivers

Just in time for the official television debut on May first comes the announcement of some twenty-odd television receivers by half as many manufacturers.

Models range from kits with a 5-inch tube for the amateur and experimenter to consoles with 14-inch tubes providing an 8 x 10 inch picture. Sight receivers utilizing the audio system of a standard broadcast receiver are offered in the lower-priced brackets, while sight-and-sound sets with all-wave pick-up on sound await those willing to pay the higher prices.

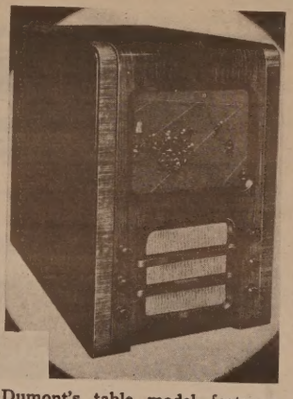
Tuning to stations is accomplished generally by pre-tuned circuits that are selected by push-button or rotary switches. A trimmer condenser often is employed to permit exact adjustment of the circuits to resonance. Three or more television channels are provided for.

20-tube Pilot model T-90 set using 9-inch tube with black and white picture.

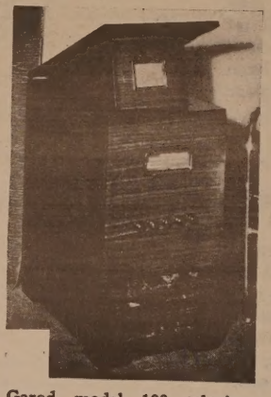


5-inch kineoscope featured in this RCA model TRK-5 sight and sound set.

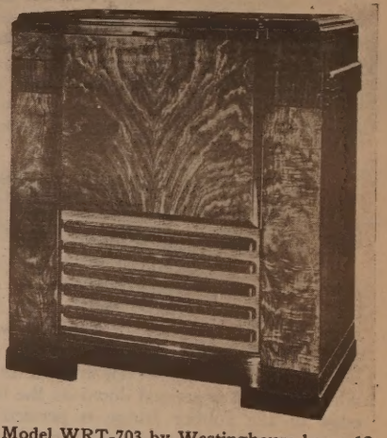
American Television's Kinet is an extension type unit.



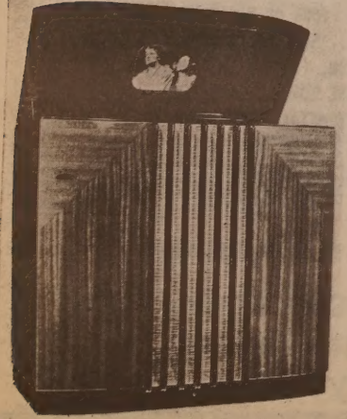
Dumont's table model features a 14-inch tube giving an 8 x 10 inch picture.



Garod model 100 televisor using a 5-inch tube. Also in kit form.



Model WRT-703 by Westinghouse has a 12-tube sound set and video chassis.



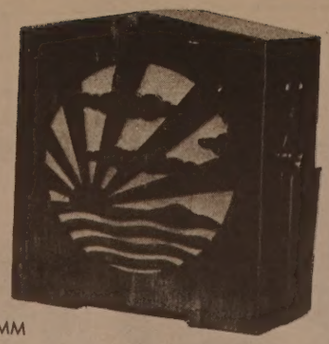
G-E model HM-225 for sight and sound. Uses 22 tubes including 9-inch cathode ray.

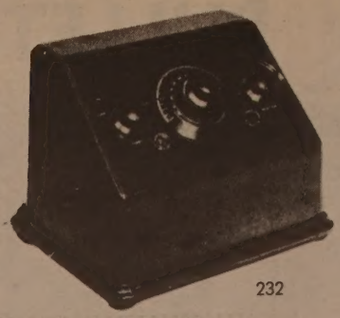
Andrea's model 1F5 sight and sound receiver with 5-inch tube is available wired or as a kit. Tunes 2 bands—in table cabinet $189.50.

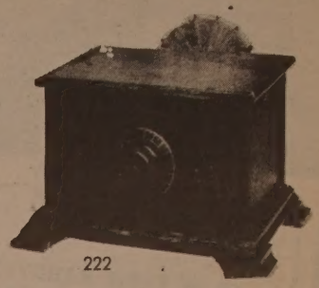
RCA-Victor model TRK-12 receiver with 12-inch tube giving 7⅜ x 9¾ picture. Image reflected by mirror on lid. Electric tuning for 9 stations. Uses 36 tubes.

Some wireless sets from the past.

T.M.C.
True Music Horn Speaker 1923
PYE
232 2 valve battery receiver 1929
222 2 valve battery receiver 1927
P/AC Mains 5 valve transportable receiver 1933
G Mains 3 valve receiver 1932
MM Mains 3 valve receiver 1932


MM


232


222

P

G

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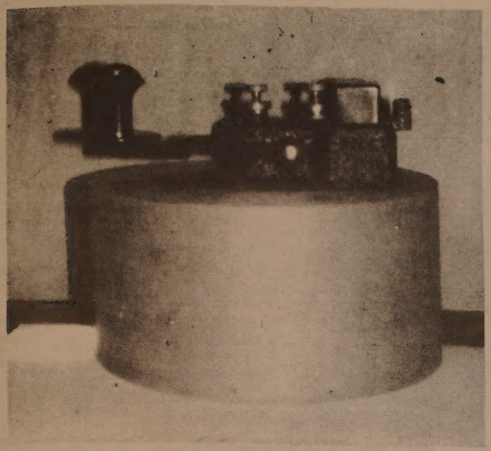

USN FLAMEPROOF KEYS, new , 1955 milspec airless sealed packages, $57.00 shipped U.S.A. telegraph items, parts, old drawings, patents and advertisements. Old galvanometer meter, etc. microphones, 1962 RCA, 1970 TEC portable and other stuff. $1.00 and SASE for illustrated 6 page list (refunded with order) Jos. Jacobs, 60 Seaview Terrace, Northport, NY 11768.

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The following list covers early radios and test equipment which was not tested but appear to be in good shape. Packing and shipping would be extra. NON-MILITARY .. 1) DELCO APPLIANCE CORPORATION, ROCHESTER NY auto radio (probably before owned by GM) model 625 complete with with built in speaker, vibrator, control head with Chevrolet symbol in dial and cables and tubes: 2) 6D6, 6A7, 6B7, 42. highest patent no. is 1,958,027, which is about 1934 vintage. $30.00. 2) PONTIAC AUTO radio model 983526. Includes separate speaker, vibrator, a control head with motorola written on dial face, tubes: 6A8G, 2) 6U7G, 6N7G, 6J5G, 6V7G, 6X5G. latest patent no. 2,027,054 which would make it about 1936 vintage. 30.00. 3) POWERTRON model 250 frequency generator. 350-450 Hertz 30.00. 4) SANBORN 500 Viso-Cardiette cardiograph. May need repair. 5.00. 5) LEAR aircraft automatic direction finder. model ADF-1203. 28V., no display head, unknown condition. 3.00. 6) RADIOLA 25, no antenna or tubes, in rough shape. 1925 vintage battery set. 20.00. 7) RADIOLA chassis for parts, about 1925 vintage. 5.00. MILITARY RADIOS.... 8) NAVY SHIP BOARD AIRCRAFT receiver model RCK. WW II vintage. Built by E. H. Scott, includes manual. Frequency range 115-156 MC. complete with tubes. some paint peeling off case. Runs on 115V. AC 1 phase. Contract date: 3/28/43. 50.00. 9) Signal corps US army transmitter unit TU-22-B. Frequency range 350-650 kc. Dated 11/1/40. Used in aircraft. 20.00. ---- Richard s. Jamieson, 325 Franklin Tpk., Ridgewood, NJ 07450. (201) 447-5331.

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TUBES, SCHEMATICS, SERVICE NOTES FOR EARLY RADIOS, SASE FOR PRICE LIST. SAM FAUST, P. O. BOX 94, CHANGEWATER, NJ 07831.

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EARLY 1960's Admiral transistor portable radios, models Y2252 or Y2082A. Send photo. Mike Hanke 1036 South 15th Avenue, Wausau, WI 4401.

LITERATURE

ORIGINAL OWNER'S MANUALS FOR RCA tube portable radios, 8BX6 and 66BX, Mike Hanke, 1036 So. 15th Avenue, Wausau, WI 54401.

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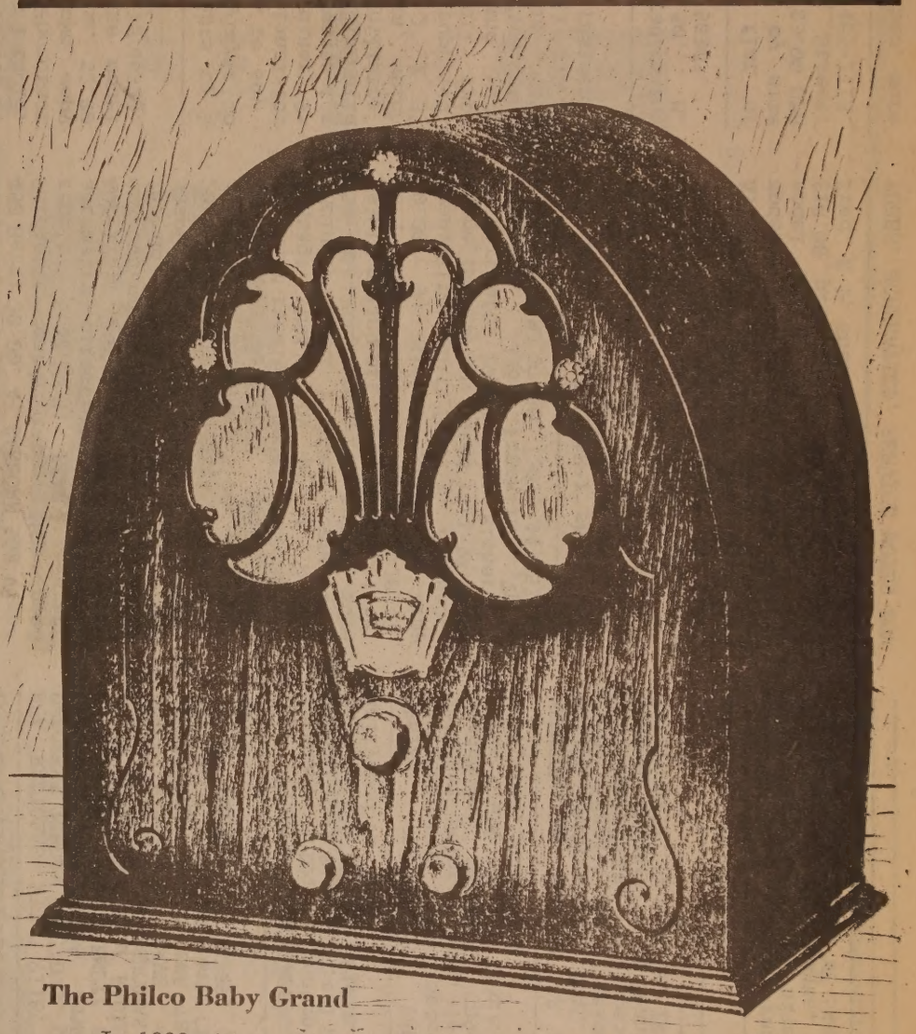

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